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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/676,936	10/01/2003	Vincent A. White	GP-302531	7848

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EXAMINER	
NGUYEN, TU MINH	
ART UNIT	**PAPER NUMBER**
3748	

DATE MAILED: 08/21/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/676,936	WHITE ET AL.	
	Examiner	Art Unit	
	Tu M. Nguyen	3748	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *11 August 2006*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-7 and 9-17* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-7 and 9-17* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *21 January 2005* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

1. An Applicant's Response filed on August 11, 2006 has been entered. Overall, claims 1-7 and 9-17 are pending in this application.

Drawings

2. The formal drawing of Figure 3 filed on January 21, 2005 has been approved for entry.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office Action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 12-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ito et al. (U.S. Patent 5,655,363) in view of Wachi et al. (U.S. Patent 6,499,474).

Re claims 12 and 16, as shown in Figures 1-4 and 7, Ito et al. disclose an engine control system for an internal combustion engine, comprising:

- a fuel injector (6) for introducing fuel into the internal combustion engine;

- a controller (5) for controlling the amount of fuel injected into the internal combustion engine by the fuel injector;

- an exhaust manifold (13) coupled to the internal combustion engine;

- a three-way catalytic converter (14) coupled to the exhaust manifold; and

- a discrete oxygen sensor (15) coupled to the catalytic converter;

wherein the controller dithers the air-fuel ratio about stoichiometry based on the discrete oxygen sensor and introduces a fuel enrichment pulse to periodically sweep the air-fuel ratio across stoichiometry, the fuel enrichment pulse introduction based upon the rate of sulfur reaction with the three-way catalytic converter (see steps S83-S85 in Figure 4, Figure 7, lines 50-56 of column 12, and line 52 of column 10 to line 5 of column 11).

Ito et al., however, fail to disclose that instead of the air-fuel ratio, the controller dithers the equivalence ratio about stoichiometry; that the discrete oxygen sensor exhibits an output of on or off based upon the oxygen in the exhaust stream; and that the controller allows a wait time to pass to allow the last calculated fuel correction to propagate the engine into the exhaust stream before introducing a later fuel enrichment pulse.

Ito et al. disclose the claimed invention except for utilizing equivalence ratio as an indicator of an exhaust gas property. It would have been obvious to one having ordinary skill in the art at the time the invention was made to use equivalence ratio in Ito et al., since the examiner takes Official Notice of the equivalence of "air-fuel ratio" and "equivalence ratio" for their use in the exhaust gas treatment art (i.e., equivalence ratio is simply the ratio of stoichiometric air-fuel ratio (i.e., 14.7) and an air-fuel ratio of an air fuel mixture), and the selection of any of these known equivalents would be within the level of ordinary skill in the art.

Since the discrete switching oxygen sensor (15) in Ito et al. exhibits the same oscillatory behavior as that in the pending application (in Figure 9 in Ito et al., the oxygen sensor (15) exhibits a sharp increase in a nearly discontinuous behavior when the exhaust gas stream changes from a lean state to a rich state, which is similar to Figure 2B in the pending application), it is obvious to one with ordinary skill in the art that the switching oxygen sensor (15) in Ito et al. exhibits an output of on or off based upon the oxygen in the exhaust stream.

As shown in Figures 1 and 8, Wachi et al. disclose an air-fuel ratio control apparatus for an internal combustion engine. They teach that it is conventional in the art to allow a wait time (TE) to pass to allow for the moving or traveling time of exhaust gases from the starting time point of every exhaust stroke for a cylinder before introducing a fuel enrichment pulse (lines 9-13 of column 13). It would have been obvious to one having ordinary skill in the art at the time of the invention was made, to have utilized the teaching by Wachi et al. in the system of Ito et al., since the use thereof would have been routinely practiced by those with ordinary skill in the art.

Re claims 13-15, the system of Ito et al. discloses the invention as cited above, however, fails to disclose that the internal combustion engine is at least one of an overhead valve engine, an overhead cam engine, and a rotary engine.

Some of the internal combustion engines for vehicles are designed to be of the rotary type to improve engine performance because of the absence of end-of-excursion power loss as the movable parts in rotary engines do not reverse direction. Other engines are configured with overhead cam or valve to achieve a compact engine and to improve volumetric efficiency.

Therefore, such disclosures by Ito et al. are notoriously well known in the art so as to be proper for official notice. It would have been obvious to one having ordinary skill in the art at the time of the invention was made, to have configured the engine of Ito et al. to be of at least one of an overhead valve engine, an overhead cam engine, and a rotary engine, since the use thereof is routinely utilized by most workers in the art of internal combustion engines for vehicles.

5. Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ito et al. in view of Wachi et al. as applied to claim 12 above, and further in view of Andersen et al. (U.S. Patent 6,634,169).

The system of Ito et al. discloses the invention as cited above, however, fails to disclose that the sulfur is removed from cerium molecules in the catalytic converter.

As shown in Figure 1, Andersen et al. teach a method and a system for maintaining efficiency of a three-way catalyst (TWC) (6) by performing periodic enrichment of the air-fuel ratio and adding secondary air to the exhaust gas so that oxidation of the unburned fuel can occur over the TWC thereby raising the TWC temperature to a sufficiently high temperature to reduce sulfur poisoning of the TWC. As indicated on lines 9-35 of column 1 and claimed in claim 2, Andersen et al. further teach that it is conventional in the art to utilize a TWC containing cerium compounds; and that sulfur purge is necessary to desorb the SOx adsorbed by the cerium compounds. It would have been obvious to one having ordinary skill in the art at the time of the invention was made, to have utilized the TWC taught by Andersen et al. in the system of Ito et al., since the use thereof would have been routinely practiced by those with ordinary skill in the art.

6. Claims 1-7 and 9-11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ito et al. in view of Andersen et al. and Wachi et al.

Re claims 1 and 7, as shown in Figures 1-4 and 7, Ito et al. disclose a method of controlling the equivalence ratio in an internal combustion engine having a three-way catalytic converter (14), comprising:

- dithering the air-fuel ratio about a stoichiometric setpoint;

- controlling the air-fuel ratio with an oxygen sensor (15); and

- periodically introducing a fuel enrichment pulse in the internal combustion engine to sweep the air-fuel ratio across stoichiometry to remove sulfur from the three-way catalytic converter (see steps S83-S85 in Figure 4, Figure 7, lines 50-56 of column 12, and line 52 of column 10 to line 5 of column 11),

wherein the oxygen sensor (15) is a discrete switching oxygen sensor.

Ito et al., however, fail to disclose that instead of the air-fuel ratio, the controller dithers the equivalence ratio about stoichiometry; that the fuel enrichment pulse is controlled to clean the cerium oxides oxygen storage sites in the three-way catalytic converter; that the switching oxygen sensor exhibits an output of on or off based upon the oxygen in the exhaust stream; and that a wait time is allowed to pass to allow the last calculated fuel correction to propagate the engine into the exhaust stream before introducing a later fuel enrichment pulse .

Ito et al. disclose the claimed invention except for utilizing equivalence ratio as an indicator of an exhaust gas property. It would have been obvious to one having ordinary skill in the art at the time the invention was made to use equivalence ratio in Ito et al., since the

examiner takes Official Notice of the equivalence of "air-fuel ratio" and "equivalence ratio" for their use in the exhaust gas treatment art (i.e., equivalence ratio is simply the ratio of stoichiometric air-fuel ratio (i.e., 14.7) and an air-fuel ratio of an air fuel mixture), and the selection of any of these known equivalents would be within the level of ordinary skill in the art.

As shown in Figure 1, Andersen et al. teach a method and a system for maintaining efficiency of a three-way catalyst (TWC) (6) by performing periodic enrichment of the air-fuel ratio and adding secondary air to the exhaust gas so that oxidation of the unburned fuel can occur over the TWC thereby raising the TWC temperature to a sufficiently high temperature to reduce sulfur poisoning of the TWC. As indicated on lines 9-35 of column 1 and claimed in claim 2, Andersen et al. further teach that it is conventional in the art to utilize a TWC containing cerium compounds; and that sulfur purge is necessary to desorb the SOx adsorbed by the cerium compounds. It would have been obvious to one having ordinary skill in the art at the time of the invention was made, to have utilized the TWC taught by Andersen et al. in the method of Ito et al., since the use thereof would have been routinely practiced by those with ordinary skill in the art.

Since the discrete switching oxygen sensor (15) in Ito et al. exhibits the same oscillatory behavior as that in the pending application (in Figure 9 in Ito et al., the oxygen sensor (15) exhibits a sharp increase in a nearly discontinuous behavior when the exhaust gas stream changes from a lean state to a rich state, which is similar to Figure 2B in the pending application), it is obvious to one with ordinary skill in the art that the switching oxygen sensor (15) in Ito et al. exhibits an output of on or off based upon the oxygen in the exhaust stream.

As shown in Figures 1 and 8, Wachi et al. disclose an air-fuel ratio control apparatus for an internal combustion engine. They teach that it is conventional in the art to allow a wait time (TE) to pass to allow for the moving or traveling time of exhaust gases from the starting time point of every exhaust stroke for a cylinder before introducing a fuel enrichment pulse (lines 9-13 of column 13). It would have been obvious to one having ordinary skill in the art at the time of the invention was made, to have utilized the teaching by Wachi et al. in the method of Ito et al., since the use thereof would have been routinely practiced by those with ordinary skill in the art.

Re claims 2 and 3, the modified method of Ito et al. discloses the invention as cited above, however, fails to disclose that the step of varying an equivalence ratio setpoint between a rich and a lean state characterized as a periodic function comprises varying the equivalence ratio between 0.9 and 1.1; and that the magnitude of the fuel enrichment pulse at least enriches the equivalence ratio by 0.1.

Ito et al. disclose the claimed invention except for specifying an optimum range of equivalence ratio setpoint between 0.9 and 1.1 and for specifying an optimum range of a fuel enrichment pulse that enriches the equivalence ratio by a magnitude of at least 0.1. It would have been obvious to one having ordinary skill in the art at the time the invention was made to provide specific optimum ranges of equivalence ratio setpoint and of fuel enrichment pulse magnitude, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233.

Re claim 4, in the modified method of Ito et al., the fuel enrichment pulse is added periodically based on the rate of sulfur poisoning of the three-way catalytic converter (step S85 is performed only when the answer in step S84 is YES).

Re claims 5 and 9, the modified method of Ito et al. further comprises determining the equivalence ratio of the internal combustion engine using an oxygen sensor (15).

Re claims 6, 10, and 11, in the modified method of Ito et al., the oxygen sensor (15) generates a discrete analog signal.

Response to Arguments

7. Applicant's arguments with respect to the references applied in the previous Office Action have been fully considered but they are not persuasive.

In response to applicant's argument that Ito et al. fail to disclose or suggest a discrete switching sensor (page 2 of the Applicant's Response), the examiner respectfully disagrees.

In Figure 9 of Ito et al., when an exhaust gas stream changes from a lean state to a rich state, the signal PVO2 of the upstream oxygen sensor (15) displays a sharp increase from a lean region to a rich region. The increase has a very large slope such that the signal is almost discontinuous with respect to an elapsed time. Without speculation, one with ordinary skill in the art immediately recognizes that this type of display is shown by a typical discrete switching oxygen sensor. Therefore, Ito et al. at least suggest the claimed limitation in dispute.

Conclusion

8. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Communication

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Examiner Tu Nguyen whose telephone number is (571) 272-4862.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mr. Thomas E. Denion, can be reached on (571) 272-4859. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Tu M. Nguyen

TMN

August 17, 2006

Tu M. Nguyen

Primary Examiner

Art Unit 3748